METHOD AND APPARATUS FOR MEASURING LIGHT REFLECTIONS OF AN OBJECT

CLAIMS

1. An apparatus for measuring light reflections of an object, the apparatus comprising:

(A) an illumination unit for providing an illumination beam (305), said illumination beam illuminating an illumination field (313) on the object;

(B) an observation unit for providing an observation beam (306), said observation beam comprising light received from an observation field on said illuminated object; said observation unit comprising at least a first observation field stop (310) adapted to define a ray boundary of said observation beam (306);

the observation unit further comprising an observation light receiver (302, 304) adapted to provide a measuring signal for determining a reflection coefficient from said measuring signal;

wherein the apparatus comprises a lens (309) common to the illumination unit and the observation unit;

characterized in

that said lens is arranged so that said illumination beam and said observation beam form an overlap therein; and

that said first observation field stop (310) comprises a wall member extending from the observation light receiver towards said lens; wherein the wall member extends only a part of the distance between the observation light receiver and the lens as to limit said ray boundary of said observation beam while maintaining said overlap of said illumination beam and said observation beam inside the lens.

2. The apparatus according to claim 1, comprising a second observation field stop (308) between the observation light receiver and the lens and displaced along the direction of propagation of said observation beam from the first observation field stop.

3. The apparatus according to claim 1 or 2, wherein said illumination unit comprises:

(a) an illumination light source, said illumination light source comprising at least one light source (301) and an illumination aperture stop (303), said at least one light source and said illumination aperture stop being arranged to provide a confined luminous field,

(b) an illumination field stop (307), said illumination field stop being adapted to provide an illumination beam (305) of light from said confined luminous field,

(c) an collimating optical element (309), said collimating optical element being adapted to collimate said illumination beam and to provide an illumination field (313) on an object;

wherein said observation unit comprises:

(a) at least a first observation field stop (310), said at least one observation field stop being adapted to provide an observation beam (306) of light from an observation field (314) on said object, said observation beam comprising a ray boundary,

(b) at least one focusing optical element (309), said at least one focusing optical element being adapted to focus said observation beam,

wherein the observation light receiver comprises a light receiver (302) and an observation aperture stop (304), said light receiver and said observation aperture stop being arranged to provide a confined receiving field of said focused observation beam;

wherein said first observation field stop is adapted to stop light from said illumination unit in reaching said observation light receiver of said observation unit.

4. The apparatus according to any one of claims 1 through 3, wherein said first observation field stop (310) extends substantially half the distance between the observation light receiver and the lens.

5. The apparatus according to any one of claims 1 through 4, wherein said first observation field stop is adapted to stop light reflections.

6. The apparatus according to any one of claims 3 to 5 wherein said collimating optical element (309) and said

focusing optical element (309) are accommodated in said lens (309).

7. The apparatus according to any one of claims 3 to 6 wherein said collimating optical element (409) has an optical axis which is displaced relative to the optical axis of said observation aperture stop (304).

8. The apparatus according to any one of claims 3 to 6 wherein said collimating optical element (409) is tilted so that its optical axis is non-parallel to the optical axis of the said observation aperture stop (404).

9. The apparatus according to any one of claims 1 to 8 wherein said illumination field stop (307) is fixed to said wall member.

10. The apparatus according to any one of claims 3 to 9 further comprising a directional optical element (311) for lateral direction of said collimated illumination beam.

11. The apparatus according to any one of claims 3 to 10 wherein said collimating optical element, said focusing element, said common optical element, and said directional optical element are selected from the group consisting of refractive optical elements, reflective optical elements, and diffractive optical elements, or a combination thereof.

12. The apparatus according to claim 11 wherein said refractive optical element is a lens, lens assembly, prism, or a combination thereof.

13. The apparatus according to claim 11 wherein said reflective optical elements is a mirror, preferably a planar mirror or a non-planar mirror, or a combination thereof.

14. The apparatus according to claim 11 wherein said diffractive optical elements is a hologram.

15. The apparatus according to claim 11 wherein said collimating optical element, said focusing element, said common optical element, and said directional optical element are accommodated in single element, said single element comprising a concave mirror, non-planar prism, or a hologram, or a combination thereof.

16. A diffuser light-source assembly, the assembly comprising:

(A) a light source (515); and

(B) a diffuser (516) with a cavity wall, said diffuser comprising:

(a) a diffusive reflecting cavity wall, said diffusive reflecting cavity wall comprising partly or wholly reflective surface elements, providing multiple reflections of said light received through a light receiving aperture, and

(b) a plurality of light emitting apertures (517), said light emitting apertures being arranged in said cavity wall

characterized in that said light emitting apertures are adapted to emit diffused light.

17. The assembly according to claim 16 wherein said light emitting apertures constituting less than 20%, preferable less than 10%, in particular 3% to 5% of said cavity wall.

18. The assembly according to claims 16 or 17 wherein said diffuser cavity wall comprises a light receiving aperture (518) said light receiving aperture being adapted to receive light from said light source.

19. The assembly according to any one of claims 16-18 wherein said reflective surface comprises a white finish applied to interior walls thereof.

20. The assembly according to any one of claims 16-19 wherein said diffuser comprises a longitudinally extending cavity having a rectangular cross section, said cavity comprising an end face accommodating said light receiving aperture (518), and a bottom face accommodating said plurality of light emitting apertures (517).

21. The assembly according to any one of claims 16-20 wherein said cavity wall comprising said plurality of light emitting apertures (517) consist of a thin perforated plate; the thickness of said plate being selected so that conditions of diffused light is maintained.

22. An apparatus for measuring light reflections of an object, the apparatus comprising:

(a) a housing;

(b) a light-source illumination-observation assembly (601-610) as defined in claims 3-15 incorporated in said housing.

23. The apparatus according to claim 22 further comprising a diffuser light-source assembly (614,615) as defined in claims 16-21.

24. The apparatus according to claim 22 or 23 further comprising means for determining a retroreflection coefficient and/or a reflection coefficient of the measured light reflections of the object.

25. The apparatus according to any one of claims 23-24 further comprising means for selecting a light source between said light source illumination-observation assembly and said diffuser light-source assembly.

26. Use of an apparatus according to any one of claims 22-25 for measuring light retroreflection, light reflection, or both.

27. Use according to claim 26 wherein the object is a reflective material, a reflective device, a retroreflector material, and a retroreflector device, or a combination thereof, in particular a road marking, a road surface, a raised pavement marking, or all.